RIETI Discussion Paper Series 25-E-067

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RIETI Discussion Paper Series 25-E-067
July 2025

Ticket Pricing and Cast Size: Evidence from 2.5-dimensional musicals in Japan

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Abstract

Using a uniquely constructed dataset, this study examines 2.5-dimensional musicals in Japan and investigates whether ticket prices tend to increase in response to an expansion in cast size. According to multiple regression analysis, ticket prices and cast size exhibit an inverted-U-shaped relationship, suggesting the presence of a certain threshold. When outliers exceeding this threshold are excluded, the number of main cast members (MCM) with official roles and titles demonstrates a substantially weaker positive correlation with ticket prices than the number of ensemble cast members (ECM) performing background roles. Moreover, the results of propensity score matching indicate that an increase in MCM size may not be reflected in higher ticket prices. A plausible interpretation of these findings is that innovations, particularly those associated with MCM, may promote productivity improvements that offset the upward pressure on ticket prices resulting from rising labor costs and increased market power in the monopolistic competition market of 2.5-dimensional musicals.

Keywords: 2.5-dimensional musical, monopolistic competition, ticket pricing, cast size, innovation.
JEL Classification: L11, L82, M21, Z11.

[1] Acknowledgement: The draft of this paper was presented at the DP seminar of the Research Institute of Economy, Trade and Industry (RIETI). We would like to thank participants of the RIETI DP Seminar for their helpful comments. We also would like to express our sincere gratitude to participants of the CAPS Workshop at the Kyoto Institute of Economic Research, Kyoto University, held on March 13, 2025, for their invaluable insights and contributions. Additionally, we provide special thanks to Professor Katharine Rockett and Professor Pierre Régibeau for their insightful suggestions.

1. Introduction

Performing arts have evolved globally over time, encompassing a variety of genres such as theater, dance, musicals, and opera (Chilvers, 2009). In Japan, although traditional forms like Noh, Kabuki, and Bunraku have been preserved and transmitted to contemporary generations, a novel genre known as “2.5-dimensional musicals” (hereafter, “2.5D musicals”) has recently emerged, particularly attracting younger audiences. This genre is defined by the transformation of originally 2-dimensional characters, derived from Japanese manga, anime, video games, novels, dramas, and so on, into the 3-dimensional space of live theatrical performances.[2] These 2.5D musicals are increasingly gaining international recognition as a distinctive form of Japanese theater, with select productions staged on Broadway in New York and in various other countries.

In the realm of traditional performing arts, state intervention is sometimes necessary to subsidize producers, as these productions often serve the public interest but operate at substantial financial deficits (Brooks, 2006; Hansmann, 1981). Conversely, 2.5D musicals function as profit-driven commercial organizations that operate independently, without requiring governmental support. This is in marked contrast to private nonprofit organizations, which prioritize public benefits over financial gains. According to PIA Corporation, although the market size of 2.5D musicals declined to 7.7 billion yen in 2020 because of the adverse effects of the COVID-19 pandemic, it rapidly rebounded to 28.3 billion yen by 2023, exhibiting a steady growth trajectory. Likewise, annual attendance reached an all-time high in 2023, with 2.89 million attendees.

The expanding market for 2.5D musicals is one of the most intensely competitive markets in the performing arts industry, in which producers engage in vigorous competition for financial returns. This market exhibits monopolistic competition, marked by a certain degree of differentiation in the content and services associated with various producers. A critical aspect of the 2.5 D musicals’ market structure is their ticket pricing strategies. Despite a discernible upward trend in inflation-adjusted ticket prices around 2019–2020 (Figure 1), certain productions continue to be priced at relatively lower levels, indicating a notable variation in ticket pricing (a detailed account of these data is provided in Section 3). Such price disparities reflect the heterogeneous cost structures of individual productions,

[2] Refer to the official website of the Japan 2.5-Dimensional Musical Association at: https://www.j25musical.jp/en/.

particularly with respect to the labor costs associated with varying cast sizes. The increasing differentiation in the content and services of 2.5D musical performances, coupled with efforts to exercise pricing power, also supports this observation under monopolistic competition (Courty, 2000; Kaplan & Menzio, 2015).

<Figure 1. Average real ticket price of 2.5D musicals (years, yen)>

Baumol and Bowen (1965, 1966) conducted seminal economic investigations of the performing arts. Through a systematic examination of the performing arts sectors in the U.S. and U.K., they identified key operational challenges. Their analysis revealed that the predominant share of operating expenditures was attributed to the labor costs associated with performers. Furthermore, a series of subsequent studies by Baumol (Baumol, 1967, 1968, 1972; Baumol et al., 1972) demonstrated that stagnant industries, such as the performing arts, experience escalating labor costs and service prices as a consequence of productivity improvements in technologically progressive industries, such as manufacturing. This phenomenon, wherein costs rise without corresponding productivity growth, is termed "Baumol's cost disease." Central to this theory is the premise that the performing arts constitute a stagnant sector with limited potential for productivity improvement. As Baumol (1993, 1996) noted, the labor productivity involved in performing Mozart's quartets has remained virtually unchanged since their inception.

Conversely, even within the same genre of performing arts, it is implausible to assert that 2.5D musicals have experienced stagnant productivity improvements solely because of Baumol's cost disease (Cowen, 1996, 2002). Producers of 2.5D musicals possess the flexibility to enhance the grandeur and appeal of a production by strategically modifying cast compositions. In such cases, producers may pass the increased labor costs on to higher ticket prices, while concurrently exercising a certain degree of market power. However, innovation is also expected to drive productivity improvements within the 2.5D musical sector by leveraging casts more effectively. Product innovations—such as the introduction of novel merchandise and ancillary services—can facilitate the adoption of a two-part pricing strategy, thereby enabling reductions in base ticket prices. Process innovations—such as the deployment of digital technologies—can augment the effective performance frequency. Collectively, these innovations are therefore likely to mitigate inflationary pressures on ticket prices by increasing overall revenue. When productivity improvements driven by innovation are considered, an expansion in cast size does not necessarily entail an increase in ticket prices.

In light of the aforementioned background, this study examines the determinants of ticket prices for 2.5D musicals by employing a uniquely constructed dataset. Econometric analyses particularly emphasize assessing the relationship between ticket prices and the number of cast members—a fundamental component of theatrical productions. A positive relationship would suggest that higher labor costs and market powers are passed on to ticket prices. Conversely, the absence of such a relationship would imply the counterbalancing productivity improvements driven by innovation. It is also possible that ticket prices and cast sizes exhibit a non-linear relationship. The analysis further distinguishes between "main cast members (MCM)," whose roles and titles are publicly disclosed by producers, and "ensemble cast members (ECM)," whose identities remain undisclosed behind the scenes. This distinction can be used to examine whether the impact on ticket pricing differs according to cast classification.

In summary, the results of the multiple regression analysis reveal an inverted-U-shaped relationship between ticket prices and cast size, suggesting that ticket prices would tend to decrease beyond certain thresholds in the number of cast members. When outliers exceeding these thresholds are excluded, the analysis further demonstrates that the positive association between ticket prices and the number of MCM is substantially weaker than that of ECM. To ensure the robustness of these results, supplementary analyses employing the propensity score matching (PCM) method establish no statistically significant average treatment effect on the treated (ATT) of the number of MCM on ticket prices, in stark contrast to the case of ECM. This contrasting disparity may be attributed to the roles undertaken by MCM in 2.5D musical productions, particularly in driving innovations that contribute to reduced ticket prices. Additionally, this study explores the specific characteristics of innovations arising within theatrical productions to substantiate the inferences derived from the analytical findings. To the best of our knowledge, this study represents the first application of economic analytical frameworks to 2.5D musicals, thereby offering a novel contribution to the economics of performing arts.

The remainder of this paper is organized as follows. Section 2 discusses the theoretical implications of the economic model of ticket pricing for 2.5D musicals. Section 3 outlines the dataset and econometric methodologies employed. Section 4 presents the empirical findings and their interpretations. Finally, Section 5 concludes with the limitations of this study and provides suggestions for future research directions.

2. Ticket pricing in the 2.5-dimensional musical industry

2.1. Characteristics of monopolistic competition

In the industrial organization literature, monopolistic competition is characterized by the following features (Belleflamme & Peitz, 2015: 88; Cabral, 2017: 80; Tirole, 1988: 287): (i) A large number of firms produce a single variety of a differentiated product. (ii) Each firm is so negligible that firms do not interact directly through strategic interdependence, but only indirectly through aggregate demand effects. (iii) There are no entry or exit barriers, leading to null economic profit. (iv) Each firm faces a downward-sloping demand curve and therefore exerts market power. In essence, a monopolistic competition market is an intermediate structure between perfect competition and a monopoly.

In this context, the 2.5D musical market deviates from the assumption underpinning perfect competition, in which the products offered by each seller are homogeneous. Although 2.5D musical productions fall within the same genre, they exhibit notable differentiation through distinct content, tailored services, and strategic casting choices, thereby enhancing their individual appeal. Audience motivations are often specific, such as the desire to attend a particular performance or see a specific actor, rather than driven solely by price considerations (de Rooij & Bastiaansen, 2017). This significant differentiation among performances affords producers a certain degree of pricing control. The market structure does not align with that of an oligopoly, characterized by strategic interdependence among a limited number of firms, given that approximately 100 productions have been staged annually over the past decade. Furthermore, the market is characterized by relatively free entry and exit for a multitude of producers. Accordingly, the 2.5D musical market is best categorized as closely resembling monopolistic competition.

Under the premise of monopolistic competition, we assume that commercial producers determine ticket prices in accordance with their profit-maximization behavior.[3] Each producer offers a distinct performance product, resulting in a downward-sloping demand curve specific to their offerings. The heterogeneity in performance productions implies that ticket prices need not coincide with the competitive prices equal to the marginal costs;

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[3] An alternative view posits that producers and performers are not motivated by the rational objective of revenue or profit maximization, but rather by the pursuit of reputation and audience satisfaction (Coate & Hoffmann, 2022; Throsby, 1994). However, these motivations are intrinsically elusive and pose significant challenges for identification within the framework of quantitative empirical analysis.

instead, prices may vary despite uniform marginal costs among producers (Courty, 2000; Kaplan & Menzio, 2015).

2.2. Theoretical analysis of an economic model

A simplified illustrative exercise is presented below to facilitate the theoretical analysis of the economic model. Let the inverse demand function faced by a producer be defined as $p = P(q)$, where p denotes the ticket price and q represents the number of production performances. It is assumed that $P'(\cdot) < 0$, indicating a downward-sloping demand curve. Moreover, the productivity improvements attributable to innovation, $I(s) \geq 1$, is posited as an increasing function of cast size s. Under these conditions, the producer's revenue is expressed as $\{P(q) \times q\} \times I(s)$. This revenue function implies that productivity improvements amplify the baseline revenue. In other words, such improvements can be interpreted as both an effective increase in price, $P(q) \times I(s)$, and/or an expansion in quantity, $q \times I(s)$. The producer's optimal pricing condition with respect to the number of performances is satisfied when marginal revenue (MR) equals marginal cost (MC), yielding the following expression:

$$MR = \{p + P'(q) \times q\} \times I(s) = MC(s). \tag{1}$$

Note that the marginal cost is also a function of cast size, although the sign of $MC'(s)$, typically positive, remains practically indeterminate.

The price elasticity of demand, defined as $e = -\frac{dq}{dp} \times \frac{p}{q}$, is posited to be a decreasing function of cast size, such that $e'(s) < 0$, which arises from the premise that an increase in cast size reinforces the producer's market power by rendering the productions more appealing and, consequently, more differentiated. Substituting $e(s)$ into Equation (1) leads to a modified form of the well-known "elasticity pricing rule": $\frac{p-MC(s)}{p} = \frac{I(s)}{e(s)}$ (c.f. Pindyck & Rubinfeld, 2017: 406). By solving for p, the following expression is obtained:

$$p(s) = \frac{MC(s)}{I(s)\left\{1 - \frac{1}{e(s)}\right\}}, \tag{2}$$

where $e(s) > 1$ is a necessary condition for ticket prices to assume a positive value. Equation (2) suggests that ticket prices are likely to increase (decrease) when (i) MC shifts upward (downward), (ii) productivity improvements diminish (intensify), and (iii) the price elasticity of demand decreases (increases).

The comparative statics of Equation (2) with respect to cast size (s) yield the condition under which an increase in cast size results in "lower" ticket prices. This condition is expressed as follows:

$$p'(s) = \frac{MC'(s)I(s)\left\{1 - \frac{1}{e(s)}\right\} - MC(s)\left[I'(s)\left\{1 - \frac{1}{e(s)}\right\} + I(s)\frac{e'(s)}{\{e(s)\}^2}\right]}{\left[I(s)\left\{1 - \frac{1}{e(s)}\right\}\right]^2} < 0. \qquad (3)$$

Equation (3) can be reformulated as the following condition:

$$\frac{I'(s)}{I(s)} > \frac{MC'(s)}{MC(s)} - \left\{\frac{1}{e(s) - 1}\right\}\frac{e'(s)}{e(s)}. \qquad (4)$$

Equation (4) delineates the conditions under which ticket prices decrease concomitantly with an expansion in cast size. Specifically, this condition requires that the proportional rate of change in productivity improvements (left side) exceed the combined effect of changes in MC (first term on the right side) and the price elasticity of demand (second term), the latter being scaled by the factor $\frac{1}{e(s)-1}$.

This derivation illustrates that despite the increase in MC and market power due to larger cast size, another critical countervailing factor, namely, productivity improvements driven by innovation, may exert downward pressure on ticket prices. Cowen (1996, 2002), who is skeptical about the Baumol's cost disease hypothesis, emphasizes that artists continually pursue innovation, driven by a relentless creative ambition. Schumpeter (1942) defined innovation as a "new combination" encompassing not only novel products and services but also advancements in production techniques, marketing strategies, and organizational structures. Productivity, even in classical forms of performing arts such as Mozart's quartets, has improved over time owing to innovations, including diversified performance modalities that expand product varieties, alongside recording technologies that facilitate increased performance frequency. These innovative practices provide a pathway to mitigate or even circumvent the cost disease traditionally linked to the performing arts.

Therefore, an increase in cast size does not necessarily translate into higher ticket prices under certain conditions when innovation is considered. The first condition is product innovation, which fosters greater audience engagement. Compelling content and ancillary services associated with cast performances can facilitate the adoption of a two-part pricing strategy in the performing arts sector. This strategy is increasingly prevalent in domains such as 2.5D musicals, where revenue is frequently augmented through the sale of related merchandise, such as Blu-rays/DVDs, pamphlets, and blind-packaged goods (Rushton, 2014).

In such cases, producers aim to maximize profits by capitalizing on ancillary goods and services associated with the stage production, rather than relying solely on ticket sales. This pricing strategy is made viable through product innovations that leverage the appeal of popular cast members to enhance the commercial potential of ancillary services. Consequently, these product innovations, fostered by the inclusion of additional cast members, are likely to improve productivity, $I(s)$, thereby increasing the effective unit price, $P(q) \times I(s)$, while making the price elasticity of demand, $e(s)$, more inelastic.

The empirical observation that the performing arts do not constitute necessary services in individuals' daily lives (Baumol & Bowen, 1966) implies that price competition is prevalent in the 2.5D musical market. Thus, innovation-driven product differentiation likely reflects a market structure shaped by competitive pricing settings (d'Aspremont et al., 1979; Shaked & Sutton, 1982). In the cultural sector, product innovation frequently materializes through differentiation efforts rather than technological advancements (Chen, 2021). In the performing arts, elements such as live talking, improvisation, and dynamic variations in choreography exemplify forms of product innovations and serve to generate appealing ancillary services that enhance overall revenue.[4]

Furthermore, there is the concurrent introduction of process innovations, encompassing technological advancements that effectively expand the performance frequency without incurring additional costs. For example, live-streaming through digital broadcasting and video distribution via Blu-rays/DVDs allow audiences to access performances remotely, thereby obviating the need for physical attendance at the theater (Cowen, 1996, 2002; Ma & Liu, 2024). Such process innovations also substantially augment the producer's overall revenue by enhancing effective performance volumes, $q \times I(s)$, assuming equivalent theater performances and ticket prices.

This theoretical analysis suggests that rising labor costs and increased market power resulting from a larger cast size may not be passed on to ticket prices if productivity improves through product and process innovations. Section 3 empirically investigates the relationship

[4] Within the context of monopolistic competition, a prevailing view suggests that information dissemination via advertising enables consumers to make more informed choices and intensifies competitive pressures, thereby exerting downward pressure on prices (Lee, 1972). Based on this logic, 2.5D musicals actively employ advertising strategies, including large-scale street visual displays, to capture public attention and attract broader audiences.

between ticket pricing and cast size using data derived from 2.5D musical productions in Japan.

3. Data and analytical methodology

3.1. Dataset

In this study, we compiled data on past theatrical productions listed in the Archives section of the Japan 2.5-Dimensional Musical Association's website. Data collection was primarily conducted by referencing the official websites of individual production organizations. In cases where official websites were no longer available, information was retrieved from the Association's website. If the data were unavailable there, secondary sources such as online news articles and Wikipedia were consulted. Ultimately, data on 909 productions from the beginning of 2014 to the end of 2024 were compiled, of which 894 productions with complete ticket price information were used in the econometric analysis. The annual distribution of these productions is presented in Table 1. As illustrated, although the number of productions abruptly declined in 2020 owing to the COVID-19 pandemic, it has rebounded thereafter, exceeding 100 productions annually since 2022.

<Table 1. Annual distribution of 2.5D musical productions>

The dataset encompasses variables such as ticket prices, cast size, theater seating capacity, original material categories, performance locations, performance duration, and the presence of production committees and sponsorship. Regrettably, as the dataset cannot be sourced from the internal financial records of individual productions, it lacks information on labor costs (e.g., cast wages) and market power (e.g., price-cost margins). A detailed examination of these variables is presented below.

With respect to ticket pricing, second-degree price discrimination, wherein seat prices vary according to perceived value, is prevalent in 2.5D musicals, which is consistent with practices observed in other performing arts sectors. Nonetheless, because this study does not aim to explore the extent of price discrimination or intra-production price dispersion (Courty & Pagliero, 2014; Krueger, 2005; Thompson, 2025), a single representative ticket price was derived for each production. Additionally, the adoption of dynamic and resale pricing remains relatively uncommon in the Japanese performing arts market. Consequently, ticket prices for

2.5D musicals may be characterized as "fixed prices" autonomously determined by producers.

To calculate the nominal ticket prices for each production when detailed information on seating categories and their corresponding prices were available, a weighted average was computed based on the number of seats allocated to each category. When present in minimal quantities, seats with severely restricted views were aggregated into the nearest appropriate seating category. During periods affected by the COVID-19 pandemic, when alternate seating was implemented and one seat was intentionally left unoccupied, seat counts were treated as if no such restrictions were in place. Seats offered at student discount rates were excluded from the calculations because of the lack of reliable information on their proportions. For performances lacking precise data on the distribution of seating categories, average seat category proportions calculated from productions with complete information were employed as proxies. Following the derivation of nominal ticket prices using this methodology, these figures were adjusted using the Consumer Price Index for theater admission (2020 base year) to obtain the real ticket prices. As shown in Figure 1, real ticket prices experienced a notable increase around 2019–2020, suggesting the possibility of a structural change in the 2.5D musical market. Therefore, controlling for year-specific effects in the econometric analysis is essential.

The theater capacity was calculated using the venue's maximum seating capacity. In cases involving multiple venues, the Tokyo venue was designated as the representative location for each production event. When multiple venues within Tokyo were utilized, the venue with the largest seating capacity was selected. The original source material for performances was categorized into the following distinct types: (i) manga, (ii) video games, (iii) anime, and (iv) drama, novels, and so on. These categories were coded as mutually exclusive dummy variables and assigned a value of 1 if applicable and 0 otherwise. Performance locations include: (i) Tokyo, (ii) Osaka, (iii) other domestic regions, (iv) Tokyo encore performances (defined as performances held initially in Tokyo, subsequently in other regions, and then returning to Tokyo), and (v) international performances. Each category was also represented by a dummy variable coded as 1 if applicable and 0 otherwise. The performance duration includes periods of closure owing to limitations in data availability. Production committees are collaborative entities led by a managing company in which multiple stakeholders, such as production companies, advertising agencies, and publishers, jointly own copyrights for a production. A dummy variable with a value of 1 was assigned if the production operated under such a committee, and 0 otherwise. Finally, if sponsorship was verified through official websites or other sources, a dummy variable was coded as 1, and 0 otherwise. The descriptive statistics of these variables are presented in Table 2.

<Table 2. Descriptive statistics>

The average real ticket price was calculated as 9,563 yen, with values ranging from a minimum of 3,272 yen to a maximum of 18,349 yen; however, the standard deviation remained relatively modest at 1,932 yen. Substantial variability was observed in the number of MCM and ECM, ranging from a minimum of 1 and 0, respectively, to a maximum of 117 and 101, with mean values of 15.7 and 5.8. Notably, all performances included at least one MCM, whereas the presence of ECM was not universal, with 288 productions featuring no ECM at all. A pronounced disparity in theater capacity was also evident, reflecting the diverse scales of productions, from intimate performances to large-scale events. The average seating capacity across venues was 1,387, indicating that not all performances were staged in large theaters. Regarding the original source materials, 46% of the products were based on manga, 28% on video games, 6% on anime, and 21% on dramas, novels, and so on. Geographically, 95% of the performances were held in Tokyo, 34% in Osaka, and 28% in other domestic regions. Tokyo encore and international performances constituted relatively small proportions, accounting for 8% and 2%, respectively. The performance duration exhibited wide variation; however, the average duration was less than two weeks, including non-performance days, suggesting that many productions were staged over comparatively short periods. Additionally, 86% of all performances were organized by production committees, whereas 18% were confirmed to have received external sponsorship.

3.2. Econometric model

This study investigates the determinants of ticket pricing in the context of 2.5D musicals in Japan, with emphasizing the relationship between ticket prices and the number of cast members, distinguished as MCM and ECM. Typically, the primary concern lies in an expansion in cast size within the performing arts sector, which is expected to increase labor costs. Therefore, a positive association between ticket prices and the number of cast members may indicate rising marginal labor costs and an intensified exercise of market power in a monopolistic competition market, as shown in Equation (4). Conversely, the absence of such a relationship may suggest the productivity improvements arising from product and process innovations driven by cast members. However, this relationship is not necessarily strictly linear. Thus, the possibility of a nonlinear relationship between ticket pricing and cast size must be considered.

In the subsequent analysis, we conduct a multiple regression with real ticket prices as the dependent variable and the number of cast members as the independent variable, employing the cross-sectional dataset outlined in Section 3.1. Adopting a general hedonic approach (Papatheodorou et al. 2009), we formally articulate the multiple regression model for production i through the following basic specification:

$$y_i = \alpha + \beta_1 \times MCM_i^2 + \beta_2 \times MCM_i + \beta_3 \times ECM_i^2 + \beta_4 \times ECM_i + \beta_5 \times MCM_i \times ECM_i + \sum_j \gamma_j \times X_{i,j} + \sum_t \delta_t \times T_{i,t} + \varepsilon_i. \quad (5)$$

Let y denote the dependent variable representing the real ticket price. MCM and ECM denote the key independent variable capturing the numbers of main and ensemble cast members, respectively. Their squared terms are incorporated to capture the potential nonlinear effects of cast size on ticket pricing. Variable X_j represents a set of j control variables, including theater capacity, dummy variables for original source materials, performance location, performance duration, and dummy variables for the production committee and sponsorship. T_t denotes year-specific dummy variables to control for year fixed effects associated with the timing of each production.[5] ε denotes the stochastic error term, capturing the residual variation not explained by independent and control variables in the model.

α, β_1 through β_5, γ_j, and δ_t are to be estimated by implementing the regression analysis. Regarding interpretations, $\beta_1 < 0$, $\beta_2 > 0$ ($\beta_3 < 0$, and $\beta_4 > 0$) indicate an inverted-U relationship between ticket prices and the number of MCM (ECM), suggesting that cast size is positively associated with ticket prices up to a certain threshold, beyond which the association becomes negative. Moreover, when the squared terms are omitted, rendering Equation (5) a linear specification, $\beta_2 > 0$ and $\beta_4 > 0$ ($\beta_2 < 0$ and $\beta_4 < 0$) imply a positive (negative) association between these two variables. A non-positive coefficient may indicate the diminished price pressure associated with rising labor costs and increased market power, potentially stemming from innovations characteristic of 2.5D musical productions operating in a competitive market environment.

[5] Incorporating fixed effects for individual MCM (totaling 14,034) is unfeasible, as it would compromise estimation accuracy given the limited sample size.

4. Results

4.1. Multiple regression

The results of the multiple regression analysis are presented in Table 3. In Estimations (1)–(5), the independent variables related to cast size are alternated across estimations. For the variables capturing the type of original source materials, manga is designated as the baseline category; thus, the coefficients for video games, anime, and dramas, novels, and so on, represent deviations relative to this baseline. To save space, the estimation results for the year-specific dummy variables are omitted. Across all estimations, the adjusted R^2 consistently surpasses 0.3, indicating a reasonably adequate model fit for the cross-sectional data. Standard errors are estimated using heteroskedasticity-robust standard errors.

<Table 3. Results of multiple regression: Baseline>

Estimations (1)–(4) incorporate the squared terms of MCM and/or ECM to capture potential nonlinear effects, whereas Estimation (5) adopts a linear specification by excluding these quadratic terms. Estimation (1), which employs MCM as the sole independent variable, yields a statistically positive coefficient for the squared term at the 5% level, whereas the linear term remains insignificant. Accordingly, Estimation (1) fails to demonstrate the robustness of the nonlinear relationship between MCM and ticket prices. By contrast, in Estimation (2), the coefficients for both the squared and linear terms are statistically significant at the 1% level, with negative and positive signs, respectively, suggesting an inverted-U relationship between the number of ECM and ticket prices. In Estimation (3), which includes both MCM and ECM, the coefficients for MCM are statistically significant at the 1% level, with the linear term displaying a positive sign and the squared term a negative sign. The coefficients for ECM maintain both their statistical significance and signs, consistent with estimation (2). Although Estimation (4) incorporates the interaction term between MCM and ECM, its coefficient is statistically insignificant, suggesting the absence of either complementary or supplementary effects of MCM and ECM on ticket pricing.

Estimation (3) allows us to calculate the vertex of the estimated inverted-U-shaped curve by identifying the threshold levels of MCM and ECM at which the relationship between ticket prices and cast size shifts from positive to negative. The calculated threshold values for MCM and ECM—33.4 ($= 37.18/(2 \times 0.556)$) and 43.9 ($= 94.69/(2 \times 1.078)$), respectively—are substantially higher than the mean (15.7 and 5.8) and median values (14 and 5), placing them approximately at the 97th and 99th percentiles. This observation implies that the inverted-U relationships are primarily driven by a limited number of outlier cases in which the values of MCM and ECM exceed the identified thresholds. To validate this inference, Estimation (5) adopts a linear specification by omitting the squared terms of MCM and ECM. The coefficient of the linear term for MCM is not statistically significant in stark contrast to that of ECM. The lack of significance for MCM suggests a markedly steeper decline in ticket prices beyond its threshold relative to ECM.

To focus on the positive linear effect of cast size on ticket pricing, Table 4 reports the results of multiple regression analyses that exclude MCM and ECM outliers exceeding the identified thresholds and incorporate only linear terms. This reduces the sample size to 866, by excluding 28 observations. Consequently, the coefficient of the linear term captures the effect of cast size on ticket pricing more precisely within the range where there exists a positive linear relationship. Whereas the linear coefficient for MCM in Estimation (6) is completely statistically insignificant, the corresponding coefficient for ECM in Estimation (7) is highly significant at the 1% level. In Estimation (8), which includes both MCM and ECM as the independent variables, the respective coefficients for MCM (17.77) and ECM (71.76) are statistically significant at the 5% and 1% levels. Although Estimation (9) also reveals statistically significant coefficients for both MCM and ECM, the interaction term remains insignificant, suggesting the absence of an interdependent relationship between the two variables. Furthermore, after excluding outliers above the 95th percentile to assess the robustness of Estimation (10), the coefficients for MCM (22.52) and ECM (91.74) increase marginally while retaining statistical significance at the 5% and 1% levels, respectively.

<Table 4. Results of multiple regression: Excluding outliers>

In practice, the quadratic estimations suggest that younger cast members, likely compensated by relatively lower wages, may be allocated preferentially to large-scale productions. Although the marginal costs of production would conventionally increase with the addition of cast members, exceptionally large-scale productions may succeed in maintaining labor costs at relatively lower levels than the others.

Nonetheless, the linear estimations reveal that the coefficient for MCM is approximately one-fourth that of ECM. This finding indicates a comparatively lower degree to which labor costs associated with MCM are passed on to ticket prices relative to ECM, considering the relatively stronger market power attributed to MCM. According to the estimated coefficients for MCM (17.77) and ECM (71.76) in Estimation (8), a one standard deviation increase in the number of MCM (8.9) and ECM (6.5) corresponds to an approximate increase of 160 yen and 466 yen, respectively, in real ticket prices. This weaker association with MCM suggests that product and process innovations, operating as productivity improvements, may alleviate the upward pricing pressure typically arising from the pass-through of labor costs and market power, thereby exerting a substantial countervailing effect.

Given that MCM often have highly dedicated core fan bases, product innovations centered around them significantly enhance audience engagement with 2.5D musical performances. Such innovations include the sale of merchandise (e.g., Blu-rays/DVDs, pamphlets, bromides, collectable cards, acrylic stands, badges, towels, penlights) as well as fan services (e.g., autograph sessions, commemorative photo opportunities). These product innovations facilitate the practical implementation of a two-part pricing strategy, thereby enabling an overall increase in revenue despite a reduction in the base ticket price. Furthermore, productions featuring popular cast members are frequently accompanied by the distribution of digital live streams and the release of Blu-rays/DVDs, enriched with supplementary materials, such as behind-the-scenes footage and exclusive interviews. Owing to the negligible marginal cost of producing such digital media, this process innovation enhances producers' revenue by increasing the effective frequency of performance.[6]

Conversely, the number of ECM exhibits a more robust and substantially positive association with real ticket prices in 2.5D productions. The divergence in the estimated results between MCM and ECM may be attributed to the limited capacity of ECM to contribute to innovation, despite their important role in supporting the overall production. In practice, it is uncommon for ECM to serve as a focal point driving the sales of character-themed merchandise and ancillary services. Indeed, 288 productions, accounting for 32.2% of

[6] Concrete examples of such innovations within 2.5D musicals are exemplified by *The Prince of Tennis* musical, commonly known as "*TENIMU*," a stage adaptation of the manga bearing the same title. Although the number of MCM in *TENIMU* is relatively high, comprising over 20 members for standard performances, the ticket price for the 2024 production was set at a modest 6,800 yen. This comparatively low pricing is attributable not only to the adoption of a "graduation" system that facilitates the inclusion of emerging younger actors, but also to the development and commercialization of a wide variety of character- and team-themed merchandise. Furthermore, *TENIMU*'s innovative live performances, centered around MCM, cater to audience engagement by incorporating interactive features that encourage real-time audience participation and vocal support.

the total sample, featured no ECM, suggesting that their inclusion may not be essential depending on the nature of the performance. Accordingly, it is reasonable to infer that ECM do not contribute substantially to innovation-driven productivity improvements capable of compensating for the associated increase in labor costs, which are consequently directly reflected in ticket prices.

In conclusion, in the performing arts industry, where labor costs constitute a substantial portion of the total expenditure, ticket prices are typically sensitive to increases in labor costs. However, the preceding analysis demonstrates that the effect of an increase in the number of MCM on ticket prices is relatively modest in comparison to ECM, arguably notwithstanding the higher wages typically associated with MCM. This distinction implies that, as emphasized by Cowen (1996, 2002), productivity improvements driven specifically by product and process innovations may be critical in alleviating the upward pressure of labor costs and market power exerted by cast size on ticket pricing.

The estimates of the control variables also produce noteworthy findings. The coefficient for theater capacity is significantly positive in Estimations (1)–(5), a finding consistent with expectations, given the typically higher costs associated with staging production in larger venues. Regarding the original source material, the coefficients for video games and dramas, novels, and so on are significantly positive at the 1% level, indicating that the real ticket prices of these categories exceed those of manga by approximately 580−730 yen and 670−770 yen, respectively. Possible explanations for these disparities include the presence of relatively older audiences with greater disposable income to attend performances in these genres despite higher ticket prices. By contrast, manga-based productions, which typically target younger generations, may adopt lower ticket pricing strategies to attract audiences of manga fans to try out 2.5D musicals for the first time. The coefficient for anime is not statistically significant across Estimations (1)−(5), and the same reasoning applied to manga-based productions may also apply to anime-based ones.

With respect to performance locations, the coefficient for Osaka is significantly positive at the 1% or 5% level, whereas the coefficient for Tokyo is statistically insignificant. Staging a performance in Osaka likely entails additional travel expenses, which may be reflected in higher ticket prices. Conversely, the coefficient for other domestic regions is significantly negative at the 5% or 10% levels, suggesting that regional income disparities may be factored into ticket pricing. The coefficient for Tokyo encore performances is significantly negative at the 1% level, with a relatively substantial magnitude of approximately 1,150−1,240 yen. When planned in advance, they may require audiences to attend essentially the same production twice, which plausibly justifies the reduction in ticket prices. The coefficient for international performances is significantly negative at the 10% level only in Estimations (2)−(4), indicating a lack of robustness. A plausible interpretation is not that international performances exert downward pressure on domestic ticket prices, but rather that productions with inherently lower ticket prices are more likely to be staged abroad, implying potential reverse causality. The coefficient for performance duration is significantly positive at the 1% level, consistent with the expectation that an extended performance duration increases venue and labor costs, thereby contributing to higher ticket prices.

The coefficient for the presence of production committees is significantly positive at the 1% or 5% levels. Unlike conglomerates, which consolidate multiple business functions within a single organization, the production committee model, characterized by joint production and shared ownership among multiple companies, tends to involve higher transaction costs (Williamson 1975), potentially increasing ticket prices. The coefficient for sponsorship is significantly negative at the 1% level, indicating a reduction in ticket prices by approximately 890−1,030 yen. In the context of 2.5D musicals, sponsorship is often provided by companies, such as ticketing companies, cosmetics firms, and convenience store chains. The sponsors are presumed to derive corporate value by demonstrating cultural engagement and by enhancing brand visibility through promotional placements on flyers and official websites.

Finally, the coefficients for the year-specific variables (omitted from the tables) across the estimations exhibit significantly positive values only from 2020 onward. The estimated differences relative to the base year of 2014 range from approximately 1,220 to 1,600 yen, with greater magnitudes observed in more recent years. However, it is unclear whether this pattern reflects the onset of Baumol's cost disease.

4.2. Robustness check: Propensity score matching method

Not only might the multiple regression analysis fail to account for all relevant covariates, but reverse causality is also possible, wherein real ticket prices influence cast size rather than vice versa. In such instances, cast size may be determined after ticket prices are set, based on anticipated audience affordability. To mitigate potential endogeneity concerns, econometrics methodologies provide several approaches, such as difference-in-differences (DID), instrumental variables (IV) techniques, and PSM. Owing to the characteristics of the cross-sectional dataset, application of the DID approach is not feasible. Moreover, the dataset lacks suitable IVs that are correlated with MCM and ECM but uncorrelated with ticket prices.

Accordingly, to verify the robustness of the results, the analysis further utilizes the PSM method developed by Rubin (1974) and Rosenbaum and Rubin (1983), which offers the advantage of not requiring a specific functional form.

This PSM approach requires a binary treatment variable, assigned a value of 1 for treated observations and 0 otherwise. In fact, the critical decision for each production pertains to whether to ”add more cast members” rather than whether to “include them.” Although converting inherently discrete variables, such as the number of MCM and ECM, into binary variables raises certain concerns, the following binary transformations are adopted to advance the empirical analysis. For the number of MCM, constructing a binary variable is necessary because no productions include zero MCM. The treatment assignment takes the value of 1 for productions with 14 or more MCM (corresponding to the median) and 0 for those with 13 or fewer MCM. With respect to ECM, 288 productions are assigned a value of 0, whereas the remaining 605 productions, each featuring more than one ECM, are designated as the treatment group, with a value of 1.[7]

The analysis employs three distinct matching methodologies: (i) kernel matching, (ii) K-nearest-neighbor matching, and (iii) caliper matching. For kernel matching, the Epanechnikov kernel function is employed with a bandwidth of 0.05. In K-nearest-neighbor matching, the five closest productions based on propensity scores are selected based on earlier studies ($k = 5$). Caliper matching is implemented with a tolerance level of 5 for the maximum propensity distance to minimize bad matches. The PSM estimations are conducted under the conditions of common support enforcement and sampling with replacement. As there are no inherently best matching methods, all three approaches are used to compare the estimation results.

The logit model is initially estimated to obtain the propensity score. The estimation results are presented in Table 5. The result of the logistic regression is particularly noteworthy: When the number of MCM (ECM) is specified as the dependent variable, the coefficients of the number of ECM (MCM) are significantly negative at the 1% level. This indicates an inverse relationship, in which the probability of including one type of cast member decreases as the number of the other increases. Among the other variables, theater capacity has a positive and statistically significant association with the probability of incorporating MCM and ECM at the 1% and 5% significance levels, respectively. With

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[7] When the outlier samples of MCM and ECM above the 97th and 99th percentiles, respectively, are excluded, the subsequent results remain largely unchanged.

respect to the original source materials, although video games and dramas, novels, and so on exhibit a negative relationship with MCM, anime and dramas, novels, and so on demonstrate a positive relationship with ECM. Performance duration, production committees, and sponsorship are exclusively correlated with MCM adoption. The pseudo *R*-squared values for the logistic regression models of MCM and ECM numbers are 0.071 and 0.063, respectively, suggesting a relatively modest model fit.

<Table 5. Determinants of cast members using logit model>

Table 6 reports the estimation results obtained from the PSM estimators, using the number of MCM and ECM as treatment variables. The upper and lower sections of the table display the results from unmatched and matched estimates, respectively. The first and second columns present the average ticket prices for the treated and control groups, respectively. The third column indicates the mean difference between these two groups, followed by standard error of the differences in the fourth column, and the corresponding t value for testing mean equivalence in the fifth column. Initially, although the unmatched mean difference for MCM (9.0 yen) between the treatment and control groups is not statistically insignificant, the corresponding difference for ECM (1123.0 yen) shows a high level of statistical significance. Across all matching methods, ATTs for MCM (34.3−154.7 yen) do not attain statistical significance. Conversely, the ATTs for ECM consistently exhibit significant positive effects (1024.1−1312.6) as the results are observed in the unmatched samples.

<Table 6. Average treatment effects computed using the propensity score matching method>

Furthermore, verifying that the means of the covariates do not significantly differ between the treatment and control groups is essential. If this condition is satisfied, the matching results can be considered robust and reliable. Table 7 shows the average covariates of each group and the standard t test for the equity of the mean sample values, along with the p value before and after matching. Prior to matching, the means of numerous covariates in both MCM and ECM differ significantly between the treatment and control groups, indicating that the two groups generally do not exhibit similar characteristics. However, following the matching procedure, the null hypothesis of equal means across groups cannot be rejected for nearly all covariates under each matching method with respect to MCM and ECM. Table 8 lists the joint significance tests and pseudo R^2. Here, |%bias| denotes the absolute percentage of the mean difference between the treatment and control groups. A considerable decrease in the mean value of |%bias|, along with the near-zero pseudo R^2 and p value of the likelihood ratio (LR) test, further indicates the effectiveness of the matching, except in the case of caliper matching for ECM, which does not pass the LR test.

<Table 7. Tests of matching covariates by balancing properties: Test statistics>

<Table 8. Tests of matching covariates by balancing properties: Joint significance tests>

Overall, the estimates derived from the PSM method, employed to mitigate potential endogeneity, are consistent with and, in some instances, reinforce the findings of the preceding multiple regression analysis. Notably, despite the limitation of dichotomizing the MCM variable at the median threshold, the PSM results indicate that MCM size has no significant influence on ticket pricing when controlling for other covariates. In contrast to the ECM case, this result further supports the hypothesis that an increase in the number of MCM may involve innovation-driven productivity improvements that alleviate upward pricing pressure.

5. Conclusion

This study focuses on 2.5D musicals in Japan as a distinct genre within the performing arts and examines the determinants of their ticket pricing. Employing an econometric approach, this study draws on a historical dataset of 2.5D musical productions to assess whether ticket prices are systematically associated with variations in cast size. Although a positive correlation is typically anticipated, whereby higher labor costs and stronger market power resulting from larger cast size are reflected in higher ticket prices within the monopolistic competition market of 2.5D musicals, this relationship is inconclusive. Theoretically, productivity improvements driven by product and process innovations may complicate the otherwise straightforward relationship between ticket pricing and cast size.

In the econometric analysis, multiple regression models are employed with ticket prices as the dependent variable and MCM and ECM as the key independent variables, along with a set of control variables. The findings reveal statistically significant inverted-U relationships between ticket prices and both categories of cast members. Upon excluding outlier observations, the number of MCM and ECM remain positively correlated with ticket pricing;

however, the magnitude of the effect for MCM is substantially smaller than that for ECM. Moreover, the application of the PSM method, in which MCM and ECM counts are dichotomized into treatment and control groups, demonstrates that MCM cast size exerts no discernible influence on ticket pricing, whereas ECM cast size has a significant positive effect. Consequently, these findings underscore that the aforementioned relationship is critically contingent on the type of cast members involved.

One plausible interpretation is that product innovations—particularly those involving merchandise sales and ancillary services associated with MCM—enable the adoption of a two-part pricing strategy. Moreover, process innovations such as digital live streaming and disc-based distribution effectively increase the frequency of performance. These mechanisms, driven primarily by MCM-related innovations, enhance productivity improvements that contribute to maintaining lower ticket prices. Nonetheless, it would be misguided to conclude from this analytical result that ECM are dispensable. Although it is evident that labor costs associated with ECM are likely to increase ticket prices, the extent to which individual wages can be suppressed is inherently limited. Therefore, to sustain competitiveness in the 2.5D musical market, producers must also pursue innovative strategies that enhance cast members' qualitative value and functional contributions.

Finally, this study has several limitations and suggests directions for future research. First, the issue of endogeneity in the econometric analysis presents a constraint; interpreting the results of multiple regression analysis as evidence of a strictly causal relationship remains problematic. To address this endogeneity issue, the analysis was supplemented with PSM. Nonetheless, identifying valid exogenous variables that influence cast size is imperative for establishing robust causal inferences. Second, although the study theoretically assumed the presence of productivity improvements, marginal costs, and market power, it was unable to incorporate variables that explicitly capture them. Future studies should aim to construct more comprehensive datasets that include detailed information, particularly on cast characteristics, such as wage data (Lemos, 2008). Third, although the present analysis focuses exclusively on the supply side (i.e., producers) based on the assumption of predetermined ticket prices, examining the demand side (i.e., audiences) is equally important (Seaman, 2006). Accordingly, future studies should strive to uncover the endogenous interplay between supply and demand, paying particular attention to audience heterogeneity.

The 2.5D musical market is expected to experience sustained growth and the performing arts landscape more broadly. Although the performing arts have traditionally been perceived as vulnerable to Baumol's cost disease owing to inherent limitations in productivity improvements, this assumption appears less applicable to 2.5D musicals. This study is anticipated to stimulate further scholarly inquiry into the performing arts more broadly, as viewed through the dual lenses of cultural and economic analysis.

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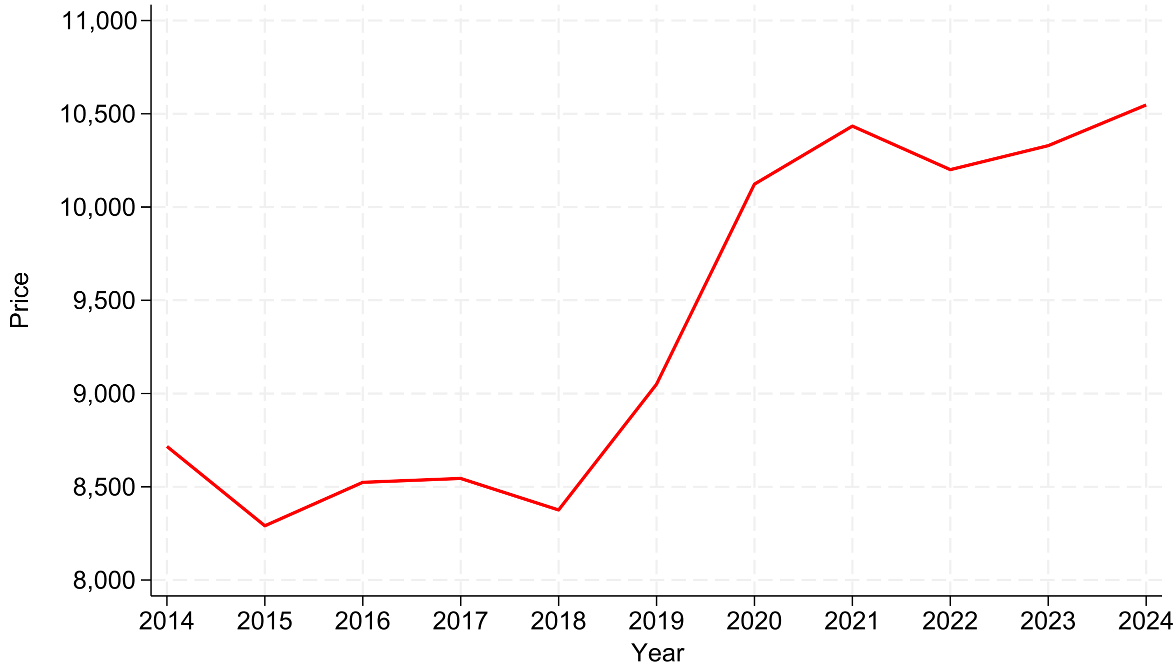
Figure 1. Average real ticket price of 2.5D musicals (years, yen)



Source: Compiled by the authors based on the dataset.

Table 1. Annual distribution of 2.5D musical productions

Year	Number of productions	Percentage	Cumulative percentage
2014	11	1.2%	1.2%
2015	50	5.6%	6.8%
2016	70	7.8%	14.7%
2017	86	9.6%	24.3%
2018	90	10.1%	34.3%
2019	88	9.8%	44.2%
2020	76	8.5%	52.7%
2021	88	9.8%	62.5%
2022	108	12.1%	74.6%
2023	121	13.5%	88.1%
2024	106	11.9%	100.0%
Total	894	100.0%	100.0%

Source: Compiled by the authors based on the dataset.

Table 2. Descriptive statistics

Variable	Mean	S.D.	Minmum	Maximum	Samples
Real ticket price (yen)	9,562.9	1,932.5	3,271.8	18,348.6	894
Number of MCM (person)	15.70	8.909	1	117	894
Number of ECM (person)	5.843	6.490	0	101	894
Theater capacity (person)	1,386.8	2,220.6	165	22,500	894
Source material: manga（1 or 0)	0.455	0.498	0	1	894
Source material: video game（1 or 0)	0.280	0.449	0	1	894
Source material: anime（1 or 0)	0.059	0.236	0	1	894
Source material: drama, novel, and so on（1 or 0)	0.206	0.405	0	1	894
Performance location: Tokyo（1 or 0)	0.953	0.212	0	1	894
Performance location: Osaka（1 or 0)	0.343	0.475	0	1	894
Performance location: other domestic regions （1 or 0)	0.281	0.450	0	1	894
Tokyo encore performance（1 or 0)	0.081	0.272	0	1	894
International performance（1 or 0)	0.021	0.144	0	1	894
Performance duration（day)	13.09	9.421	1	77	894
Production committee（1 or 0)	0.858	0.349	0	1	894
Sponsorship（1 or 0)	0.183	0.387	0	1	894

Table 3. Results of multiple regression: Baseline

	(1)		(2)		(3)		(4)		(5)	
Number of *MCM* ^{2}	-0.424	***			-0.556	***	-0.555	***		
	(0.153)				(0.124)		(0.151)			
Number of *MCM*	17.60				37.18	***	37.18	***	3.833	
	(12.40)				(11.44)		(11.43)		(9.179)	
Number of *ECM* ^{2}			-1.029	***	-1.078	***	-1.078	***		
			(0.136)		(0.132)		(0.133)			
Number of *ECM*			89.78	***	94.69	***	94.78	***	63.03	***
			(11.00)		(10.92)		(16.20)		(22.09)	
Number of *MCM* * *ECM*							-0.005		-0.880	
							(0.639)		(0.675)	
Theater capacity	0.129	***	0.071	**	0.081	**	0.081	**	0.086	**
	(0.039)		(0.033)		(0.035)		(0.035)		(0.039)	
Video game	726.9	***	575.9	***	610.6	***	610.6	***	625.2	***
	(131.0)		(122.9)		(128.0)		(128.1)		(130.9)	
Anime	301.0		205.7		242.3		242.3		245.1	
	(206.8)		(202.8)		(203.6)		(204.2)		(206.0)	
Drama, novel, and so on	769.5	***	669.1	***	708.9	***	709.0	***	676.4	***
	(171.8)		(167.7)		(165.8)		(166.4)		(168.1)	
Tokyo	223.7		91.78		125.66		125.61		89.21	
	(452.4)		(431.7)		(427.3)		(428.2)		(437.7)	
Osaka	340.8	***	303.9	**	283.9	**	283.9	**	292.9	**
	(122.6)		(118.6)		(118.1)		(118.2)		(120.4)	
Other domestic regions	-302.0	*	-276.1	*	-280.9	*	-280.9	**	-321.5	**
	(158.7)		(153.2)		(152.8)		(153.1)		(158.0)	
Tokyo encore performance	-1239.7	***	-1152.0	***	-1180.5	***	-1180.5	***	-1169.6	***
	(233.2)		(220.6)		(218.9)		(219.0)		(221.4)	
International performance	-396.9		-494.1	*	-466.5	*	-466.4	*	-433.5	
	(269.5)		(268.1)		(281.8)		(281.6)		(265.1)	
Performance duration	37.10	***	29.91	***	27.88	***	27.88	***	31.80	***
	(11.21)		(10.42)		(10.48)		(10.48)		(10.94)	
Production committee	404.0	**	460.5	***	387.9	**	387.8	**	439.7	***
	(161.9)		(158.0)		(159.0)		(159.2)		(158.1)	
Sponsorship	-1030.2	***	-903.2	***	-892.6	***	-892.6	***	-947.4	***
	(168.8)		(163.6)		(160.1)		(160.4)		(166.5)	
Constant term	7250.8	***	7350.0	***	6978.4	***	6978.2	***	7394.9	***
	(616.0)		(589.0)		(598.5)		(597.9)		(604.3)	
Year dummies	Yes		Yes		Yes		Yes		Yes	
Adjusted R^2	0.342		0.377		0.386		0.386		0.361	
Sample size	894		894		894		894		894	

Note 1: The values in parentheses indicate heteroskedasticity-robust standard errors.

2: ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 4. Results of multiple regression: Excluding outliers

	(6)		(7)		(8)		(9)		(10)	
Number of *MCM*	4.682				17.77	**	28.59	**	22.52	**
	(9.410)				(9.046)		(11.972)		(10.84)	
Number of *ECM*			68.00	***	71.76	***	104.22	***	91.74	***
			(9.502)		(9.512)		(26.192)		(12.66)	
Number of *MCM* * *ECM*							-2.228			
							(1.632)			
Theater capacity	0.155	***	0.122	**	0.105	**	0.114	**	0.142	**
	(0.053)		(0.051)		(0.049)		(0.048)		(0.062)	
Video game	675.3	***	530.1	***	578.1	***	573.2	***	596.0	***
	(134.0)		(125.0)		(130.6)		(130.2)		(136.2)	
Anime	266.9		185.1	*	228.7		239.3		169.5	
	(208.9)		(204.9)		(205.8)		(206.7)		(208.3)	
Drama, novel, and so on	723.4	***	639.7	***	669.8	***	679.8	***	618.8	***
	(173.0)		(167.8)		(167.0)		(167.1)		(171.7)	
Tokyo	187.1		109.6		62.21		29.34		259.26	
	(506.2)		(488.8)		(483.7)		(481.9)		(515.2)	
Osaka	360.2	***	306.9	***	300.5	**	298.3	**	288.6	**
	(123.7)		(119.5)		(119.1)		(119.4)		(127.1)	
Other domestic regions	-331.3	**	-322.8	**	-320.3	**	-322.3	***	-303.6	*
	(162.5)		(157.0)		(156.6)		(156.6)		(168.2)	
Tokyo encore performance	-1330.4	***	-1235.8	***	-1271.1	***	-1296.6	***	-1176.3	***
	(240.7)		(227.5)		(225.4)		(227.2)		(252.0)	
International performance	-421.7		-500.6	*	-456.3		-438.8		-349.3	
	(284.7)		(283.1)		(288.8)		(286.0)		(350.0)	
Performance duration	36.42	***	28.77	***	27.17	**	25.74	**	20.16	
	(11.58)		(10.80)		(10.81)		(11.10)		(12.69)	
Production committee	425.8	***	443.1	***	407.6	**	408.2	**	475.0	***
	(162.1)		(157.5)		(159.3)		(160.7)		(162.6)	
Sponsorship	-994.8	***	-891.4	***	-887.4	***	-879.8	***	-904.7	***
	(173.5)		(168.1)		(165.5)		(165.3)		(174.1)	
Constant term	7507.2	***	7513.9	***	7360.2	***	7244.2	***	7009.7	***
	(646.0)		(640.9)		(635.1)		(632.0)		(652.8)	
Year dummies	Yes		Yes		Yes		Yes		Yes	
Adjusted R^2	0.338		0.373		0.375		0.377		0.374	
Sample size	866		866		866		866		798	

Note 1: The values in parentheses indicate heteroskedasticity-robust standard errors.

2: ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 5. Determinants of cast members using logit model

	Number of MCM		Number of ECM	
Number of MCM			-0.072	***
			(0.012)	
Number of ECM	-0.051	***		
	(0.013)			
Theater capacity	0.0003	***	0.0001	**
	(0.0001)		(0.00005)	
Video game	-0.700	***	0.246	
	(0.176)		(0.186)	
Anime	-0.497		0.781	**
	(0.305)		(0.376)	
Drama, novel, and so on	-0.533	***	0.432	**
	(0.192)		(0.211)	
Tokyo	0.375		0.645	
	(0.413)		(0.415)	
Osaka	0.013		0.174	
	(0.164)		(0.175)	
Other domestic regions	-0.017		0.062	
	(0.187)		(0.200)	
Tokyo encore performance	-0.124		0.567	
	(0.340)		(0.608)	
International performance	-0.213		-0.264	
	(0.535)		(0.343)	
Performance duration	0.025	**	0.005	
	(0.011)		(0.011)	
Production committee	0.804	***	0.258	
	(0.206)		(0.216)	
Sponsorship	-0.392	*	-0.225	
	(0.209)	*	(0.216)	
Constant	-0.825	*	0.615	
	(0.470)		(0.483)	
Log likelihood	-571.5		-526.4	
Psuedo R^2	0.071		0.063	
Sample size	894		894	

Note 1: The values in parentheses indicate heteroskedasticity-robust standard errors.

2: ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 6. Average treatment effects computed using the propensity score matching method

	Treated	Control	Difference	S.E.	*t* value	On support
Treatment variable: number of MCM						
Unmatched	9566.9	9557.9	8.97	130.0	0.07	
ATT						
Kernel	9583.9	9429.1	154.7	159.3	0.97	879
K-nearest-neighbor	9576.5	9542.2	34.28	181.1	0.19	882
Caliper	9576.7	9494.9	81.86	185.9	0.44	876
Treatment variable: number of ECM						
Unmatched	9924.6	8801.6	1123.0	133.2	8.43	
ATT						
Kernel	9925.3	8901.2	1024.1	299.5	6.79	893
K-nearest-neighbor	9925.3	8898.8	1026.5	159.2	6.45	893
Caliper	9925.3	8612.7	1312.6	197.8	6.64	893

Table 7. Tests of matching covariates by balancing properties: Test statistics

	Unmatched				Matched											
					Kernel				K-nearest neighbor				Caliper			
	Mean		*t* test		Mean		*t* test		Mean		*t* test		Mean		*t* test	
	Treated	Control	*t* value	*p* value	Treated	Control	*t* value	*p* value	Treated	Control	*t* value	*p* value	Treated	Control	*t* value	*p* value
Treatment variable: Number of MCM																
Number of ECM	5.330	6.598	-2.90	0.004	5.101	5.218	-0.33	0.742	5.100	5.150	-0.14	0.888	5.123	4.4835	1.89	0.059
Theater capacity	1327.5	1027.9	2.78	0.006	1202.8	1189.3	0.15	0.878	1248.2	1175.2	0.82	0.412	1185.1	1234.5	-0.57	0.569
Video game	0.248	0.323	-2.44	0.015	0.247	0.237	0.36	0.716	0.248	0.249	-0.05	0.964	0.246	0.248	-0.08	0.939
Anime	0.054	0.069	-0.96	0.340	0.055	0.052	0.21	0.833	0.054	0.044	0.70	0.484	0.055	0.051	0.30	0.767
Drama, novel, and so on	0.181	0.238	-2.07	0.038	0.175	0.185	-0.38	0.707	0.176	0.180	-0.14	0.890	0.176	0.207	-1.18	0.238
Tokyo	0.968	0.958	0.77	0.443	0.978	0.971	0.66	0.512	0.974	0.972	0.16	0.871	0.978	0.956	1.86	0.063
Osaka	0.371	0.303	2.11	0.035	0.368	0.362	0.18	0.854	0.367	0.403	-1.10	0.273	0.367	0.360	0.21	0.836
Other domestic region	0.284	0.251	1.12	0.262	0.276	0.246	1.02	0.306	0.278	0.240	1.34	0.181	0.275	0.224	1.76	0.078
Tokyo encore performance	0.095	0.062	1.78	0.075	0.096	0.060	2.05	0.041	0.096	0.069	1.49	0.137	0.095	0.044	3.02	0.003
International performance	0.026	0.017	0.85	0.395	0.026	0.018	0.86	0.389	0.026	0.014	1.32	0.188	0.026	0.013	1.43	0.154
Performance duration	13.86	12.28	2.50	0.013	13.85	12.74	1.87	0.062	13.89	13.33	0.92	0.358	13.78	12.09	2.94	0.003
Product committee	0.899	0.804	3.98	0.000	0.899	0.892	0.36	0.722	0.900	0.898	0.09	0.930	0.899	0.914	-0.80	0.426
Sponsorship	0.175	0.171	0.13	0.897	0.177	0.145	1.32	0.186	0.176	0.153	0.94	0.346	0.174	0.165	0.35	0.724
Treatment variable: Number of ECM																
Number of ECM	14.08	18.67	-7.92	0.000	14.11	13.66	1.23	0.219	14.11	13.52	1.60	0.109	14.11	13.74	1.00	0.316
Theater capacity	1198.9	1521.6	-2.13	0.033	1183.2	1164.1	0.18	0.857	1183.2	1162.9	0.19	0.849	1183.2	1172.7	0.09	0.927
Video game	0.269	0.247	0.71	0.478	0.268	0.272	-0.14	0.886	0.268	0.272	-0.16	0.872	0.268	0.263	0.20	0.839
Anime	0.077	0.035	2.40	0.017	0.077	0.057	1.34	0.181	0.077	0.054	1.52	0.128	0.077	0.054	1.57	0.116
Drama, novel, and so on	0.230	0.170	2.03	0.043	0.230	0.217	0.53	0.599	0.230	0.223	0.31	0.754	0.230	0.236	-0.21	0.832
Tokyo	0.959	0.938	1.38	0.167	0.961	0.943	1.41	0.160	0.961	0.940	1.57	0.116	0.961	0.945	1.27	0.206
Osaka	0.332	0.347	-0.46	0.648	0.332	0.314	0.66	0.509	0.332	0.317	0.55	0.583	0.332	0.309	0.83	0.406
Other domestic region	0.257	0.306	-1.51	0.131	0.255	0.264	-0.31	0.755	0.255	0.266	-0.41	0.683	0.255	0.284	-1.08	0.282
Tokyo encore performance	0.057	0.101	-2.34	0.020	0.057	0.055	0.18	0.861	0.057	0.060	-0.20	0.839	0.057	0.071	-0.97	0.330
International performance	0.020	0.014	0.60	0.550	0.018	0.013	0.60	0.549	0.018	0.017	0.14	0.891	0.018	0.020	-0.22	0.826
Performance duration	12.09	13.44	-2.24	0.026	12.10	11.86	0.51	0.611	12.10	11.97	0.27	0.787	12.10	11.99	0.22	0.828
Product committee	0.865	0.851	0.55	0.583	0.864	0.851	0.62	0.535	0.864	0.847	0.82	0.415	0.864	0.882	-0.90	0.370
Sponsorship	0.157	0.219	-2.24	0.026	0.155	0.188	-1.45	0.149	0.155	0.190	-1.52	0.129	0.155	0.198	-1.88	0.060

Table 8. Tests of matching covariates by balancing properties: Joint significance tests

	Before	After		
		Kernel	K-nearest neighbor	Caliper
Number of MCM				
Mean of |% bias|	14.70	4.29	4.55	6.11
Pseudo R^2	0.070	0.006	0.008	0.013
LR chi-squared value	85.67	7.53	10.03	16.82
LR test p value	0.000	0.873	0.692	0.208
Number of ECM				
Mean of |% bias|	11.99	3.73	4.08	7.27
Pseudo R^2	0.060	0.005	0.005	0.020
LR chi-squared value	67.67	8.50	9.19	33.18
LR test p value	0.000	0.810	0.758	0.002